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A Review of Larval Host Records for Australian Jewel Beetles (Coleoptera: Buprestidae).

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Abstract

Larval food plant records for 37 species in 15 genera of Australian Buprestidae are summarized from the literature and previously unpublished information. Observations on ovipositing females of 2 species in 2 genera are also recorded. Photographs of the adults of *Araucariana queenslandica* Levey, *Pseudotaenia waterhousei* (Van de Poll), *Stigmodera* (*Stigmodera*) *goryi* Laporte & Gory, *S. (S.) roei* Saunders, *Stigmodera* (*Themognatha*) *heros*

Gelin, *S. (T.) imperialis* Carter and *S. (T.) martini* Saunders, and larvae of *P. waterhousei* and *S. (T.) heros*, are provided. Although much information is yet to be gained on larval hosts, some trends are apparent. Most buprestid genera breed in one or two plant genera. A majority of the plant species utilized are primitive members of the Australian flora (as presently recognized by botanists) having undergone speciation from Gondwanaland before or shortly after the breakup of the continents.

Introduction

Very little information is available on

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the larval food plants of Australian Buprestidae. Froggatt (1892) first recorded the unusual behaviour of *Ethon* and *Cissers* larvae which breed in galls of *Dillwynia* and *Pultenaea* (Fabaceae) in the Sydney area. Froggatt (1893, 1894, 1895) furthered work on the life histories of some Australian Coleoptera and mentioned their food plants, including records for some Buprestidae, but unfortunately, did not continue work on larval buprestid biology.

Little attention was paid to breeding biology of jewel beetles until McMillan (1950a, b, 1951, 1952) recorded observations on several Western Australian Buprestidae. Both Froggatt's and McMillan's work however, is of limited value to present day studies on larval taxonomy and morphology.

Hadlington and Gardner (1959) provided the only extensive work on the biology of an Australian buprestid when they examined *Diodoxys erythrinus* (White) in western New South Wales. However, the eggs, larva and pupae of this species, remain to be described in detail.

Levey (1978a) has provided the only detailed description of an Australian buprestid larva and provided brief notes on the biology of *Prosppheres aurantiopicta* (Laporte & Gory).

The present paper summarizes all the published information on larval food plants of Australian Buprestidae and adds a number of previously unpublished records. It is hoped that this work will be a basis for further work since so little is known about buprestid biology.

Some information has been taken from specimens in the following institutions:— Queensland Museum (QM); Queensland Dept. of Forestry (QDF); Queensland Dept. of Primary Industries (QDPI); Australian Museum (AM); South Australian Museum (SAM); and the Western Australian Museum (WAM). Other unpublished data from

the authors' personal observations and those of Mr M. Powell and Mr M. De Baan are included. The remaining records are taken from the scant and scattered literature and from H. W. Brown's private diary. The distribution on a state basis, follows each species name in parentheses. Species and genera are arranged according to the most recent nomenclature.

Larval food plants are recognized as those from which larva(e) and/or pupa(e) have been extracted or plants from which adult(s) has have emerged or been collected.

List of species and larval food plants

Sub family Polycestinae, Tribe Polycestini

1. *Prosppheres aurantiopicta* (Laporte & Gory) (Q, NSW, SA, NT) Levey (1978a) records *Arancaria cunninghami* Don (Araucariaceae) as a larval food plant from Imbil, south east Queensland, larvae and adults were collected from log billets on 13 April 1972 by R. A. Yule. Another record is *Pinus patula* Schlet & Cham (Pinaceae), adults were collected at Glastonbury, Queensland on 24 Nov 1967, by N. W. Sheather (Levey, 1978a). Levey (1978a, pp. 122-125) has described the larva of *P. aurantiopicta* in detail.

Sub family Chalcopterinae, Tribe Epistomentini

2. *Arancaria queenslandica* Levey (Q) (Fig. 1) Levey (1978b) records single females from *Arancaria cunninghami* Don from Innisys Scrib, south east Queensland on 30 Dec 1971 and Imbil State Forest, south east Queensland on 21 Dec 1971, both records collected by R. A. Yule.

3. *Diodoxys erythrinus* (White) (Australia-wide) Hadlington and Gardner (1959) recorded *Callitris huegelii* (Carr.) Franco and *C. endlicheri* (Parr.) C. M. Bail (Cupressaceae) as the main larval hosts. French (1911) and Prescott (1932) have recorded the introduced tree *Cupressus macrocarpa* var. *lambertiana* Gordon (Cupressaceae) as a host in the Melbourne area. French (1911) also believed that *Acacia aneura* F. Muell. (Mimosaecae) was a host plant since he collected specimens from an area where no species of *Callitris* or *Cupressus* occurred. There since have been

no verifications of French's record; it is possible that the specimens emerged from processed timber or bred in *Pinus* or other conifers in the area where French collected. Recently, M. De Baar, M. Hockey and R. A. Yule have collected larvae and adults from *Callitris columellaris* F. Muell. in the Dunmore State Forest, south-east Queensland in March 1981.

4. *Diadoxus scalaris* (Laporte & Gory) (NSW, V, SA, WA). Hadlington and Gardner (1959) recorded *Callitris huegelii* (Carr.) Franco and *C. endlicheri* (Parl.) F. M. Bail. (Cupressaceae) as the main larval hosts.

Sub-family Chalcophorinae, Tribe Chalcophorini.

5. *Pseudotaenia waterhousei* (Van de Poll) (NSW, Q.). (Fig. 2). Mr M. De Baar is presently investigating some aspects of the biology of the species which breeds in living stems of *Acacia leiocalyx* (Domin) Pedley (Mimosaceae) in central south-east Queensland.

6. *Pseudotaenia spilota* Carter (WA). Breeds in *Acacia grasbyi* Maiden (Mimosaceae) on Yarlalweelor Station, north-west of Meekatharra, Western Australia (M. Powell, 1981, pers. comm.).

Sub-family Chalcophorinae, Tribe Julodimorphini.

7. *Julodimorpha bakewellii* (White) (WA, SA, V). Carter (1929) recorded the species as breeding in roots and trunks of mallee trees (*Eucalyptus* sp.) in inland Australia. Data on one female in the WAM, collected by A. M. Douglas on 3 Sept. 1978, 12 km E of Greenhead, W.A., records the beetle ovipositing 2.5 cm below the ground in damp sand near the base of an unidentified *Calothamnus* plant (Myrtaceae).

Sub-family Chrysobothrinae, Tribe Chrysobothrini.

8. *Chrysobothris* sp. (Q.). One of us (T.J.H.) found larvae, pupae and adults of an undescribed *Chrysobothris* sp. breeding in the dead stems of *Acacia bidwillii* Benth. (Mimosaceae) on 5 Dec. 1981, at Townsville, north Queensland. A paper describing the species biology in detail will be published separately.

9. *Merinnia atrata* (Hope) (Australia wide). One of us (M.P.) observed adults laying eggs into smouldering bark at the base of a *Eucalyptus* (*Corymbia*) *calophylla* R.Br. ex Lindl. (Myrtaceae) at Cannington, Perth. *M. atrata* is commonly known as the fire-beetle

because of its habit of flying into camp fires, bush fires and to bright lights (Poulton, 1915). Fires appear to be an important part of its biology. As the species is widespread, it probably breeds in numerous native plants throughout Australia.

Sub-family Buprestinae, Tribe Agrilini.

10. *Ethon affine* Laporte & Gory (Q, NSW, V). Froggatt (1892) recorded this species breeding in galls on the stems of *Pultenaea stipularis* Sm. (Fabaceae) in May 1891 in the Sydney area. Froggatt noted "The galls containing the perfect insect, which were in the majority, were more soft and spongy than those containing the larvae; as the beetles do not emerge until the early summer months they must stay a considerable time in these galls after having undergone their metamorphoses". *Ethon affine* adults are present in Sept. — Oct., in the Sydney district on *Pultenaea* and flowering *Jacksonia scoparia* R.Br. (Fabaceae).

11. *Ethon corpulentum* Boheman (NSW, V, SA). Froggatt (1892) recorded this species breeding in galls in the roots of *Dillwynia retorta* (Wendl.) Druce (as *D. ericifolia* Sm.) (Fabaceae) in the Sydney area. Nothing further has been recorded on its biology.

12. *Cisseis acuducta* (Kirby) (Q, NSW, V, SA). Froggatt (1892) recorded this species breeding in galls in the roots of *Dillwynia retorta* (as *D. ericifolia*) in the Sydney area. Hawkeswood (1978) and M. Peterson (pers. obs.) have found adults on non-flowering and flowering *Jacksonia scoparia* in the Lapstone Hill area of the lower Blue Mountains from late Sept. — Dec.

13. *Cisseis maculata* Laporte & Gory (NSW, V, Tas, SA). Froggatt (1895) recorded this species breeding in dead branches of *Acacia longifolia* (Andrews) Willd. (Mimosaceae) at Rose Bay, Sydney and noted adults feeding on leaves of the plant.

14. *Cisseis semiscabrosa* Laporte & Gory? (*C. scabrosula* Kerremans?) (NSW, V). Froggatt (1895) recorded this species breeding in *Acacia longifolia* at Rose Bay, Sydney. Carter (1929) does not list *C. semiscabrosa* neither as a valid species nor a synonym. We suspect Froggatt may have found *C. scabrosula* Kerremans, which is found in coastal N.S.W. (Hawkeswood, 1981a) and Victoria.

15. *Paracephala cyaneipennis* Blackburn (NSW). Froggatt (1894) recorded this species breeding in small, rounded galls on the bran-

ches of *Casuarina distyla* Vent. (Casuarinaceae) at Rose Bay in Sydney. The beetle is rare in museum collections and little is known of its biology. Hawkeswood (1978) found an adult on *C. torulosa* Ant. in the Blue Mountains.

16. *Agathis mastersi* Macleay (Q). Specimens have emerged from log billets of *Acacia leiocalyx* (Domin) Pedley (Mimosaceae) which were collected from the Dunmore State Forest, central south-eastern Queensland in Nov. 1980 by M. De Baar.

Sub-family Buprestinae, Tribe Buprestini.

17. *Nasico sinuilinea* Van de Poll (Q). One of us (T.J.H.) found a dead adult under the bark of the Grey Ironbark *Eucalyptus (Symphyomyrtus) drepanophylla* F. Muell. ex Benth. (Myrtaceae) on 10 April 1981 at Townsville, north Queensland. This species has been rarely recorded.

18. *Nasico vetusta* (Boisduval) (NSW, V). The following larval host records are known for this species from adult specimens lodged in the N.S.W. Forestry Commission Collection, Sydney: Berowra, Sydney, 1 Dec. 1970, J. English; Middle Cove, Sydney, 28 May 1973, G. Dougherty (adult emerged 26 Oct. 1973); Pymble, Sydney, 4 Nov. 1964, K. G. Campbell (in main trunk). (All the above specimens in *Eucalyptus (Monocalyptus) haemastoma* Sm.); Lisarow, N.S.W., 21 Aug. 1954, K. M. Moore (in old fallen branch of *Eucalyptus (Symphyomyrtus) saligna* Sm.; Beccroft, Sydney, 22 Nov. 1981, E. E. Taylor, in *Eucalyptus (Symphyomyrtus)* sp. (Ironbark); Willoughby, Sydney, 17 Oct. 1980, E. E. Taylor (heavy infestation), in *Metrosideros* sp. All food plants are from the family Myrtaceae.

19. *Melobasis cupriceps* (Kirby) (NSW, Q, V, Tas). Froggatt (1895) recorded this species (as *M. iridescens* Laporte & Gory) breeding in branches of *Acacia longifolia* (Mimosaceae) at Rose Bay, Sydney and noted adults fed on *Viminaria demidata* Sm. (now known as *V. jumea* (Schrader, Hoff.) (Fabaceae).

20. *Melobasis purpurascens* (Fabricius) (Australia wide). Froggatt (1895) also recorded this species (as *M. splendida* (Donovan)) breeding in *Acacia longifolia* at Rose Bay, Sydney. Ericke (1964) records adults emerging from an unknown fruit tree at Ashfield, Sydney.

21. *Melobasis sexplagata* Laporte & Gory (SA, WA, V). McMillan (1950 a, b) recorded notes on the general biology of this rare

species which breeds in trunks of *Eucalyptus (Symphyomyrtus) indus* Endl. in south west Western Australia.

22. *Anilura* sp. (near *A. obscura* (Macleay) (NSW). An unidentified *Anilura* species has been recorded breeding in, and causing extensive damage to, *Flindersia maculosa* (Lindl.) Benth. (Rutaceae) on 23 March 1966, at Moree, N.S.W. by K. M. Moore (NSW Forestry Commission).

Sub-family Buprestinae, Tribe Achenusini.

23. *Astracis irregularis* Van de Poll (WA, SA, V, Q). Goudie (1920) records this taxon breeding in the branches of *Casuarina leuhmanniana* R. F. Baker (as *C. leuhmanni*) at Birchip, Victoria. Like most species of *Astracis* it is found, as adults, on the leaves and branches of *Casuarina* species (Peterson, unpub. data).

24. *Astracis prothoracicus* Van de Poll (WA, NSW, Q). Females of this species have been observed ovipositing on the cones of *Banksia prionotes* Lindl. (Proteaceae) at Jurien Bay, W.A. (M. Powell, pers. comm.) in November. Adults are usually recorded entering on this plant (W.A. only).

Sub-family Stigmoderinae, Tribe Stigmoderini.

25. *Curis intercalibrata* Fairmaire (W.A.). McMillan (1951) provided brief notes on the species breeding in *Casuarina glauca* Sieb. ex Spreng. (Casuarinaceae) in Western Australia.

26. *Stigmodera (Stigmodera) cancellata* (Donovan) (W.A.). Whitlock (1947) recorded the species breeding in *Agonis flexuosa* (Spreng.) Schan. (Myrtaceae), while McMillan (1952) recorded "Peppermints" (*Agonis*) as host.

27. *Stigmodera (Stigmodera) goryi* Laporte & Gory (NSW, Q) (Fig. 4). (a) On 3 Feb. 1981, Mrs N. Gawthorne of Toongabbie, Sydney, N.S.W. found an adult female which had died after attempting to emerge head first from the trunk of a *Eucalyptus (Symphyomyrtus) tereticornis* Sm. (Myrtaceae) after being trapped in small square mesh chicken wire which was tightly wrapped around the base of the tree. (The specimen was later lodged in the AM). One of us (M.P.) visited Toongabbie and examined the tree and emergence holes. The most recent hole, about 1 m above ground level, measured 1.5 cm wide, 1.25 cm high and at least 7.0 cm deep. Other emergence holes ranged from 1.6 m above ground level on the main trunk

only. Despite the number of bore holes the tree was alive and healthy. (b) Two adults which emerged from *Eucalyptus* (*Symphyomyrtus*) *amplifolia* Naud. in Feb. 1969, at Stanthorpe, south-east Queensland, were collected by Mrs J. Harslett and are housed in her collection. (c) One female emerged from an unknown *Eucalyptus* sp. on 16 Dec. 1929 and was collected by H. Hacker at Kinkin, Queensland and is housed in the QM. (d) One male cut from an unknown *Eucalyptus* sp. on 19 Dec. 1963 at Fletcher, south Queensland is in the E. Sutton collection of the QM. (e) H. W. Brown recorded specimens cut from "living grey gums", (*Eucalyptus* sp.), on 12 Dec. 1912 at One Tree Hill (now Mt Coot-tha), Brisbane, south-east Queensland.

28. *Stigmodera* (*Stigmodera*) *gratiosa* Chevrolat (WA). McMillan (1952) recorded *Melaleuca* and *Leptospermum* (both Myrtaceae) as "breeding plants" for this Western Australian species.

29. *Stigmodera* (*Stigmodera*) *roei* Saunders (WA). (Fig. 5). McMillan (1952) noted that in coastal areas of south-west Western Australia the species breeds in *Agonis flexuosa* (Spreng.) Schaur. (Myrtaceae).

30. *Stigmodera* (*Themognatha*) *excisicollis* Macleay (NSW, Q). An adult female from Sunnybank (Brisbane), Queensland, was "chopped out of dead grey gum" (*Eucalyptus* *Symphyomyrtus*) *propinqua* Deane et Maiden (Myrtaceae) and is housed at QDPI.

31. *Stigmodera* (*Themognatha*) *flavocincta* Laporte & Gory (SA, WA, V). Goudie (1923) recorded the species breeding in *Eucalyptus* (*Symphyomyrtus*) *leucoxydon* F. Muell. in north-western Victoria.

32. *Stigmodera* (*Themognatha*) *heros* Gehin (NSW, V, SA, WA). (Fig. 6). A specimen in SAM collection, collected on 28 June 1895, by A. B. Barrand, emerged from the trunk of an unidentified mallee, *Eucalyptus* sp., at Streaky Bay, South Australia.

33. *Stigmodera* (*Themognatha*) *imperialis* Carter (WA). (Fig. 7). On 25 Jan. 1938, H. W. Brown cut adults of this species from *Eucalyptus* (*Symphyomyrtus*) *striaticalyx* W. V. Fitz. at Milly Soak (Lake Austin-Cue district), Western Australia.

34. *Stigmodera* (*Themognatha*) *martini* Saunders (WA). (Fig. 8). One collection in the WAM, collected on 18 Jan. 1958 by R. P. McMillan records a male cut from a root of



Fig. 1. *Araucariana queenslandica* Levey. Bar indicates 10 mm. (Photograph by M. Peterson).



Fig. 2. *Pseudotaenia waterhousei* (Van de Poll). Bar indicates 20 mm. (Photograph by M. Peterson).



Fig. 3. Last instar larva of *Pseudotaenia waterhousei* (Van de Poll). Bar indicates 30 mm. (Photograph by M. Peterson).

Casuarina corniculata F. Muell. (Casuarinaceae).

35. *Stigmodera* (*Themognatha*) *similis* Saunders (NSW, Q). H. W. Brown recorded this species breeding in *Casuarina* sp. at Gladstone, Queensland.

36. *Stigmodera* (*Themognatha*) *suturalis* (Donovan) (NSW). K. M. Moore collected larvae on 12 Jan. 1965, from *Casuarina torulosa* Ait. at Lisarow (near Gosford), N.S.W.

37. *Stigmodera* (*Castiarina*) *rufipennis* (Kirby) (NSW, V, SA, WA). Froggatt (1893) recorded *Acacia brownii* (Poir.) Steud (Mimosaceae) (as *Acacia juniperina* Willd.), as a larval host from the Bendigo district, Victoria. Froggatt (1893) noted the larva fed on the stems of the *Acacia* hollowing out the majority of wood from the stems.



Fig. 4. *Stigmodera* (*Stigmodera*) *goryi* Laporte & Gory. Bar indicates 20 mm. (Photograph by M. Peterson).

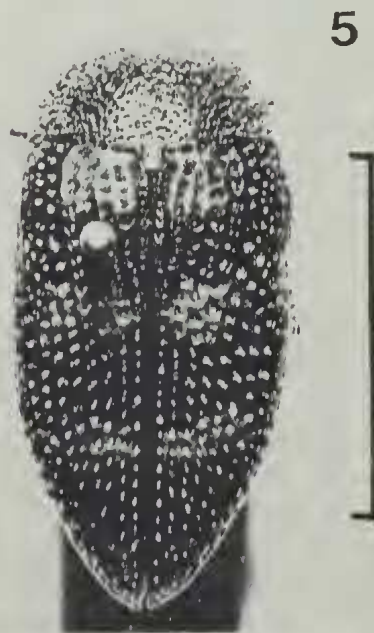


Fig. 5. *Stigmodera* (*Stigmodera*) *roei* Saunders. Bar indicates 20 mm. (Photograph by M. Peterson).



Fig. 6. Adult and last instar larva of *Stigmodera* (*Themognatha*) *heros* Gehin. Bar indicates 40 mm. (Photograph by M. Peterson).



Fig. 7. *Stigmodera* (*Themognatha*) *imperialis* Carter. Holotype, National Museum of Victoria (NMV). Bar indicates 15 mm. (Photograph by M. Peterson).

38. *Stigmodera* (*Castiarina*) *verdiceps* Barker (WA). H. W. Brown bred a male beetle from an unidentified *Acacia* sp. on 23 Dec. 1946, from Port Samson, north-west Western Australia (Barker, 1979).

39. *Stigmodera* (*Castiarina*) *producta* Saunders (NSW, Q). A specimen in the NSW Dept. of Forestry Collection collected at Lisarow, near Gosford, N.S.W., on 13 Aug. 1954 by K. M. Moore, records "*M. eucalyptifolia*" as a larval host. We consider "*M. eucalyptifolia*" to be *Muellerina eucalyptifolia*, which is a synonym for the mistletoe *Muellerina eucalyptoides* (DC.) Barlow (Loranthaceae) (Barlow, 1966; Barlow and Weins, 1973).

Discussion

Of a total of about 800 species of Buprestidae recorded from Australia, only 37 (or c. 5%) of this total have food plants listed for them. The lack of knowledge of larval biology is further exemplified in the fact that the larva of

only one species, *Prospheres aurantiopicta* Laporte & Gory, has been described in detail (Levey, 1978a).

Although the larval food plant data listed in the present paper is somewhat scanty and many of the records need further verification (i.e. some of the earlier records may have listed misidentified plant species) and relatively few host records have been made, some trends seem apparent and worthy of comment.

Levey (1978a) noted that the subfamily Polycestinae (Tribe Polyetesini) to which *Prospheres* belongs, appeared to be a relict group of the Buprestidae although some genera such as *Sponsor* (non-Australian) appeared to have undergone a period of recent speciation. Levey (1978a) also noted that the distribution, host associations and distinctiveness of the *Prospheres* species

suggests that the genus is an archaic one, which originated in the middle Cretaceous (c. 100 million years B.P.) or earlier. The association between the pine *Araucaria* (Araucariaceae) and *Prospheres* is probably therefore an ancient one, and the general association between conifers and other Polyctesini similarly may be ancient (Levey, 1978a).

Levey (1978b) erected a new tribe Epistomentini but did not state the sub-family to which it belonged. The present authors have assumed that it belongs to the sub-family Chalcophorinae. The new tribe now contains *Epistomentis* Solier (non-Australian), *Cyria* Solier (Australian), *Diadoxus* Thomson (Australian), *Cyrioxus* Hoshchek (non-Australian) and the new genus *Araucariana* (Australian). As with *Prospheres* and the other Polyctesini, the members of the Epistomentini, especially *Araucariana*, *Diadoxus* and *Cyria* breed in softwood timbers, usually conifers (Pinaceae and Araucariaceae).

Levey (1978b) noting the relict distribution of the Epistomentini (i.e. *Epistomentis* in Chile and Argentina, *Cyrioxus* in New Caledonia and *Diadoxus* and *Araucariana* in Australia), suggested that, as with the

Polyctesini, the group originated in the southern hemisphere and their present distribution is the result of the breakup of Gondwanaland. Like *Prospheres aurantiopicta* Laporte & Gory, *Araucariana queenslandica* Levey is known to breed in *Araucaria cunninghamii* G. Don and is probably also a primitive buprestid. *Diadoxus* species are definitely known to breed in softwood conifers (i.e. *Callitris* and *Cupressus*, both Cupressaceae, and may also breed in introduced *Pinus*, Pinaceae). Likewise, *Diadoxus* must be considered archaic members of the Buprestidae although evolved more recently than *Prospheres* and *Araucariana* since the distribution of the Australian genus *Callitris* tends to be in the arid and semi-arid areas of Australia and these plants presumably evolved during the drying of the central Australian land mass around 40 million years B.P., well after the breakup of Gondwanaland. *Cyria* has been suggested to breed in *Banksia* (Proteaceae) although the authors have been unable to obtain any published records or museum specimens bred from *Banksia* species. *Cyria imperialis* (Fabricius) however, is known to feed on *Banksia spinulosa* Sm. leaves in the Blue Mountains, N.S.W. (Hawkeswood, 1978) and do not visit flowers for food (Hawkeswood and Peterson, unpub. data).

Levey (1978b) noted the plant taxa associated with these three genera, i.e. *Araucaria* (*Araucariana*), *Callitris* (and *Cupressus*) (*Diadoxus*) and *Banksia* (*Cyria*), probably originated in the southern hemisphere and suggests an evolution from Gondwanaland. However, we feel that *Diadoxus* may have evolved during the time when Central Australia was drying out after the Gondwanaland breakup. The utilization of *Callitris* and *Cupressus* is unlikely to be a recent event in the evolution of *Diadoxus*. On the basis of



Fig. 8. Two adults of *Stigmodera* (*Themognatha*) *martini* Saunders. Bar indicates 20 mm. (Photograph by M. Peterson).

the host plant association, *Cyria* would not appear to be as old as *Diadoxus*, since *Banksia* is one of the most recent groups evolved in the Proteaceae (Johnson and Briggs, 1963, 1975). The earliest fossils of *Banksia*-like plants have been found in rocks dating back to the early Tertiary (Oligocene), c. 35 million years B.P. (Cookson and Duigan, 1950), compared to c. 100 million years B.P. when *Prospheres* and *Aracuaniana* probably began evolving from buprestid ancestors, and at least 40-50 million years B.P. for *Diadoxus*. However, on the basis of *Cyria*'s similarity to the South American genus *Epistomentis*, both these genera probably originated in Gondwanaland and therefore *Cyria* would be of similar age as *Prospheres* and *Aracuaniana* and older than *Diadoxus*.

It is possible that *Cyria* originally bred in a more primitive Proteaceous genus than *Banksia*, but changed to *Banksia* as the southern areas of Australia dried out.

The majority of Australian Buprestidae with known larval hosts, breed in hardwoods, i.e. *Acacia* (Mimosaceae) and *Eucalyptus* (Myrtaceae). The apparent close association between many genera of Buprestidae and *Acacia* (i.e. *Melobasis*, *Chrysobothris*, *Pseudotaenia*, *Agrilus*, *Cisseis*) as well as *Eucalyptus* (i.e. *Merimna*, *Julodimorpha*, *Nascio*, *Melobasis*, *Stigmodera* (*Themognatha*)) suggests a long period of co-evolution, since Australian *Acacia* appears to have speciated at about the same time as the *Eucalyptus* in the late Cretaceous, about 80-90 million years B.P. (L. Pedley, 1982, pers. comm.).

The genus *Pseudotaenia* appears to have a strong relationship with *Acacia* — the larvae breed and feed in the wood and adults probably feed on the leaves. *Pseudotaenia waterhousei* (Van de Poll) breeds in *Acacia leiocalyx* (Domin) Pedley (a member of the Juliflorae, a

sub-group of *Acacia* considered to be primitive and originating in northern Australia; L. Pedley, 1982, pers. comm.). The association with primitive *Acacias* of northern Australia may explain the northern distribution of *Pseudotaenia* and other members of the sub-family Chalcophorinae in Australia.

Chrysobothris, *Agrilus* and *Cisseis* also appear to have a strong association with *Acacia*, with the larvae breeding in the stems and adults usually feeding on the leaves only. Some members of *Cisseis* (i.e. *C. acuducta* (Kirby)) and *Ethon* (i.e. *E. affine* Laporte & Gory and *E. corpulentum* Boheman) (considered by some to be a sub-genus of *Cisseis*), have diverged to breed in members of the Fabaceae. These taxa have been recorded to produce galls, in which the larvae feed and grow, on their food plants, an unusual habit for beetles. This specialization probably indicates a much more recent evolution than the other related species of *Cisseis* and *Melobasis*, which breed in *Acacia* and do not produce galls as far as we are aware.

Two species of *Stigmodera* (*Castiarina*) breed in *Acacia* (i.e. *S. verdiceps* Barker and *S. rufipennis* (Kirby)). Since this sub-genus is the largest of *Stigmodera* with over 300 species (many of which are widespread and occur in a number of habitats), numerous food plants from a range of families are probably utilized. Some *Castiarina* species may utilize only one food plant while others may breed in one species with adults feeding on two or more. For instance, adults of *Stigmodera* (*Castiarina*) *scalaris* (Boisduval) are known to have an association with *Cassinia uncata* A. Cunn. ex DC. (Asteraceae) flowers, but also may visit flowers of *Angophora bakeri* C. Hall and *Leptospermum flavescens* Sm. (both Myrtaceae) in one area of the lower Blue Mountains, N.S.W. (Hawkeswood, 1978, pp. 260-261). Whether or not this beetle breeds in all

these food plants, two or one only, remains to be determined.

Many buprestids have been recorded breeding in *Eucalyptus*, one of the largest genera in Australia with over 600 species. Johnson (1972) divided the genus into 8 sub genera, with *Monocalyptus* and *Symphyomyrtus* the largest, with 91 and 285 species, respectively (from a total of 443 species he examined). *Corymbia* is next with 33 species (Johnson, 1972). It is therefore interesting to note that a majority of Australian Buprestidae which breed in *Eucalyptus*, (i.e. *Julodimorpha*, *Merinna*, *Nascio* and *Stigmodera*) breed in *Symphyomyrtus* species — *Nascio similissima* Van de Poll (*E. drepanophylla*); *N. vetusta* (Boisduval) (*E. saligna*); *Stigmodera* (*S.*) *goryi* Laporte & Gory (*E. amplifolia*, *E. tereticornis*); *S. (T.) excisicollis* Maelenay (*E. propinqua*); *S. (T.) flavocincta* Laporte & Gory (*E. leucoxydon*); *S. (T.) imperialis* Carter (*E. striatocalyx*) and *Melobasis sexplagiata* Laporte & Gory (*E. rudis*). Only one record, that of *N. vetusta* breeding in *E. haemastoma*, is known for *Monocalyptus*, while *M. atrata* was observed laying in the bark of *E. calophylla*, a *Corymbia* species. The remaining records are of unidentified *Eucalyptus* species.

Johnson (1972) suggested a polyphyletic evolution for *Eucalyptus*. There can be little doubt that *Eucalyptus* is of ancient Australian origin and although the fossil record does not show the appearance of *Eucalyptus* until the mid-Tertiary (Oligocene) (c. 30-35 million years B.P.), the genus was probably well advanced by the late Cretaceous (c. 80 million years B.P.). Therefore, the association between the species of *Nascio*, *Stigmodera*, *Julodimorpha*, *Merinna* and *Melobasis* and *Eucalyptus* appears to be an ancient one and probably co-evolutionary. *Symphyomyrtus* has radiated more widely than the other groups of

Eucalyptus and therefore the probability of buprestids breeding in *Symphyomyrtus* species is greater than in other sub-genera which have fewer species.

The record of *Stigmodera* (*Castanina*) *producta* Saunders breeding in *Muellerina eucalyptoides* (DC.) Barlow (Loranthaceae) is of much interest. We are unaware of any published reports of beetles breeding in Australian mistletoes or any overseas species of Loranthaceae or Viscaceae. (Several Buprestidae are known to visit flowers of *Nyctia floribunda* (Labiell.) R.Br. (Hawkeswood, 1981b), a Western Australian relict genus of the Loranthaceae, but it is not known whether any of these breed in the mistletoe). Barlow (1966) noted that *Muellerina* is a primitive genus and suggested that the early development and diversification of the Loranthaceae occurred in the late Mesozoic (c. 65-70 million years B.P.) when the geography and climate allowed more extensive distribution across the southern land masses (Barlow, 1963). The association between *S. (C.) producta* is possibly an ancient one (unless the record is erroneous, or the larva tunneled into the mistletoe from the eucalypt on which the mistletoe was parasitic). Whatever is the case, further research is needed before a better understanding of the beetle/mistletoe relationship is gained.

The genus *Casuarina* (Casuarinaceae) contains about 70 species, distributed in Madagascar, Malaysia, Polynesia and Australia (which has 30 species). The present disjunct distribution of *Casuarina* can be partly explained by the break up of Gondwanaland where the genus probably originated c. 100 million years B.P. Further speciation of *Casuarina* occurred during the drying of the Australian land mass in the mid-Tertiary, probably at about the same time as *Eucalyptus* and *Acacia* were radiating, c. 30-35 million years B.P.

Casuarina species are important hosts to a number of Australian Buprestidae — *Paracephala cyaneipennis* Blackburn (*Casuarina distyla*); *Astracis irregularis* Van de Poll (*C. leuconanthus*); *Curis intercribrata* Fairmaire (*C. glauca*); *Stigmodera* (*Themognatha*) *suturalis* (Donovan) (*C. torulosa*); *S. (T.) martini* Saunders (*C. corniculata*) and *S. (T.) similis* Saunders (*Casuarina* sp.). None of these buprestids are known to breed in any other plants. *Astracis* is regarded as a primitive genus of the Polycestinae (Levey, 1978a) (although is probably not as ancient as *Prospheres* and *Arancaria*) and *Paracephala* appears to be a primitive member of the Buprestinae. *Curis*, one of the most primitive genera of the Stigmoderinae, is also known to occur in South America (Carter, 1929) and probably originated in Gondwanaland before the breakup occurred. Later speciation of *Curis* occurred throughout many dry areas of Australia, especially in Western Australia where the genus is well developed (Carter, 1929). Similar speciation appears to have occurred also in, for example, *Diadoxus*, *Chrysobothris*, *Pseudotaenia* and *Stigmodera* (*Themognatha*). Species of *Astracis*, *Curis* and *Stigmodera* (*Themognatha*) have probably undergone a long period of co-evolution with *Casuarina* (i.e. 80 million years), although *Astracis* is regarded by Levey (1978a) to have undergone a more recent speciation.

The genus *Flindersia* (Rutaceae) contains about 16 species of small to large trees distributed throughout eastern Australia, the Moluccas, New Guinea and New Caledonia (Armstrong, 1975). Australia has 14 species and 10 of these are restricted to the rainforests of eastern Australia, although none occurs in Tasmania. *Flindersia maculosa* (Lindl.) F. Muell. is one of four Australian species not confined to rainforests but grows in the dry open areas of central New South Wales and

Queensland. It is likely that the genus originated in the southern hemisphere and that the rainforest species are more primitive than the arid-adapted ones. Little is known of the biology and taxonomic relationships of *Anilura*, but the *Anilura* species (near *A. obscura* Macleay) recorded breeding in *F. maculosa*, is likely to be a recently evolved species.

To conclude, in most cases, the relationships between Australian Buprestidae and their larval food plants, appear to be ancient ones, with many probably originating in Gondwanaland before or after the breakup, c. 80-100 million years B.P. or even later. This view is based on the available larval food plant records which, although fragmentary, show that some primitive genera e.g. *Prospheres* and *Arancaria*, breed in *Arancaria* pines. Other genera e.g. *Diadoxus*, *Chrysobothris*, *Pseudotaenia*, *Melobasis* and *Stigmodera*, breed in relatively primitive plants such as *Eucalyptus*, *Acacia* and *Casuarina*, (which although not as primitive as *Arancaria*, probably originated in Gondwanaland or evolved from Gondwanaland ancestors). Many buprestid genera probably co-evolved with these plant genera.

Much information is yet to be gathered on food plants of Australian Buprestidae. With the disappearance of habitats as a result of land-clearing practices by man, it is imperative that further records are made in order that a better understanding of the biology, distribution and ecology of Australian Buprestidae can be gained.

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